UNIVERSITY OF SASKATCHEWAN

College of Engineering

G.E. 120.3

Introduction to Engineering II

FINAL EXAMINATION #2

April 14, 2001

2:00 PM - 4:00 PM

STUDENT NAME: _____

STUDENT NUMBER: _____

LECTURE SECTION:
- L02 Tu-Th 11:30 – 1:00 Prof. T.G. Crowe
- L04 Tu-Th 1:00 – 2:30 Prof. H.C. Wood
- L06 Tu-Th 2:30 – 4:00 Prof. R.J. Bolton

Question 1	/ 15
Question 2	/ 5
Question 3	/ 15
Question 4	/ 15
Question 5	/ 5
Question 6	/ 15
Question 7	/ 15
Question 8	/ 15
TOTAL	/ 100

GENERAL INSTRUCTIONS FOR THE QUESTIONS

1) **NO** textbooks, **NO** notes, **NO** assignments, and **NO** laboratory logbooks/reports.
2) **NO calculators allowed**.
3) Neatness counts. Please ensure your paper is readable.
4) Some questions contain special instructions. Please ensure that you read these carefully.
5) Not all questions are of the same difficulty and value. Consider this when allocating time for the solution.
6) *IF A QUESTION PROVES TO BE TOO HARD FOR YOU TO SOLVE, GO ON TO ANOTHER QUESTION! RETURN TO THE TROUBLESOME QUESTION WHEN TIME PERMITS.*

PLEASE NOTE

ALL parts of the examination paper MUST be handed in before leaving.

Please check that your examination paper contains 11 pages TOTAL.

QUESTION #1

MARKS: 15 (5 + 5 + 5)

Answer each of the following questions. A few short sentences should be sufficient. **Numerical answers are not required**.

a) In the Geological Engineering project laboratory it was noted that after the mine was closed not all of the waste rock and the mill tailings would fit back into the the pit. Briefly explain the reason for this.

b) In the Engineering Physics project laboratory, it was noted that data from a fourth (or more) GPS satellite is used when calculating the position? Briefly explain the reason for this.

c) In the Agriculture and Bioresource Engineering project laboratory it was noted that a shear plate was used during testing. Briefly expain the reason for this.

QUESTION #2

MARKS: 5 (5)

"U2" have a concert that starts in **17 minutes** and they must all cross a bridge to get there. You must help them (with advice only) cross to the other side. All four men begin on the same side of the bridge. It is at night and there is only one flashlight. A maximum of two people can cross (or be on) the bridge at one time. Any party that crosses, either 1 or 2 people, must have the flashlight with them. The flashlight must be walked back and forth (i.e., it cannot be thrown, etc.).

Each band member walks at a different speed. A pair must walk together at the rate of the slower man's pace:

- Bono: 1 minute to cross the bridge
- Edge: 2 minutes to cross the bridge
- Adam: 5 minutes to cross the bridge
- Larry: 10 minutes to cross the bridge

For example, if Bono and Larry walk across first, 10 minutes have elapsed when they get to the other side of the bridge. If Larry then returns with the flashlight, a total of 20 minutes have passed and you have failed your mission.

QUESTION #3

MARKS: 15 (15)

The point **p** = (20, 40) in the xy-plane is to be transformed using a series of 2D geometrical transformations. It is to be rotated +90° , then translated by T_x = 20 and T_y = -60, and then scaled using S_x = -1 and S_y = -1.

What are the new coordinates of the point **p'**? All work must be clearly shown.

QUESTION #4

MARKS: 15 (3+3+3+3+3)

Answer each of the following where **u** = [2 -3 4] and **v** = [-2 -3 5].

a) $\mathbf{u} \cdot \mathbf{v}$

b) $\mathbf{u} \times \mathbf{v}$

c) Cos θ, where θ is the angle between **u** and **v**

d) Sin θ, where θ is angle between **u** and **v**

e) The projection (vector) of **u** on **v**

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QUESTION #5

MARKS: 5 (5)

Given two points **u** = [6 3 1] and **v** = [2 2 1] and the line g^T = [3 -4 2], find which point is on the line and the distance from the other point to the line.

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QUESTION #6

MARKS: 15 (3+3+3+3+3)

Answer each of the following questions.

a) Find all solutions to the equation: $x^2 - 4x + 5 = 0$

b) Evaluate the following expression and present the solution in rectangular **and** polar forms.
$(2 + 3i) * (1 - 2i)$

c) Evaluate the following expression and present the solution in rectangular **and** polar forms.
$$\frac{1 + i\sqrt{3}}{1 - i\sqrt{3}}$$

d) Evaluate the following expression and present the solution in **either** rectangular **or** polar form.

$$(1-i)^8$$

e) Evaluate the following expression and present the solution in **either** rectangular **or** polar form.

$$e^{-1+\frac{ip}{2}}$$

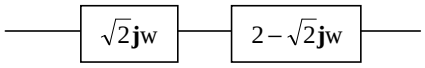
QUESTION #7

MARKS: 15 (6+9)

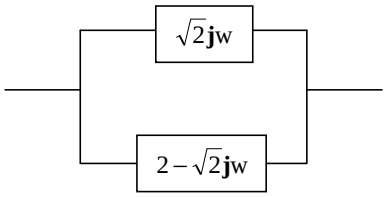
Answer each of the following questions.

We know that the equivalent resistance of 2 resistors ($\mathbf{R}_1$ and $\mathbf{R}_2$) in series can be evaluated by $\mathbf{R}_1 + \mathbf{R}_2$. Likewise, 2 resistors in parallel have an equivalent resistance of $\frac{\mathbf{R}_1\mathbf{R}_2}{\mathbf{R}_1 + \mathbf{R}_2}$. Given that complex impedances can be treated in similar ways, calculate the equivalent impedance of the following networks, where the complex impedances of the individual components have been identified. Express each equivalent impedance in rectangular **and** polar forms.

a)



b)



QUESTION #8

MARKS: 15 (5+5+5)

Engineers are concerned that the spring melt this year will take out a bridge on the river. They have the following information available:

-The bridge deck is horizontal with one 60-meter span from one vertical abutment to the other

-At end A, the river bed meets the abutment 2.0 m below the bottom of the deck of the bridge

-At the other end, the river bed meets the abutment 1.0 m below the bottom of the deck. The abutments define the widest part of the flow beneath the bridge.

-At distances of 10, 20, 30, 40, and 50 m from end A, the river bed is 6, 14, 22, 21, and 13 meters below the bottom of the deck of the bridge, respectively.

-The flow velocity when the river is full (water to the bottom of the deck) is 1.0 m/s, assumed uniform over width and depth.

a) What is the maximum flow capacity of the river in m^3/s ?

b) Currently, the water is 10 m below the bottom of the deck of the bridge, and flowing at a uniform speed of 0.5 m/s. What is the flow rate of the river now?

c) Reservoir engineers estimate that over a 3 day period next week, the equivalent of 3 cm average depth of melt water from a watershed of 550,000 hectares will enter the river at a uniform rate. (there are 100 hectares in l km^2 of land). Can the river handle this extra flow without water impacting the bridge deck?